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Abstract

Samples were taken at different locations of Houston during the summer of 2000. A high volume impactor with 8"x10" quartz filters was used. The impactor typically ran for 24 hours. Samples were taken once every 3 days at the Clinton site and once every 6 days at the Galveston, Harris and HCNW sites. The concentration of beryllium-7 on the filters was determined by counting the gamma rays emitted as the isotope decayed. A 4" germanium crystal was the gamma rays detector with a multichannel analyzer (MCA) that records the number of signal pulses occurring at different pulse heights. For nuclear MCAs, the input signals usually come from a detector and the height of the pulse is proportional to energy.

Abstract (cont.)

The region of interest (ROI) when analyzing a sample for the concentration of beryllium-7 is from 472-481 keV. After controlling the background to be as lowest as possible, the filters were analyzed and the data was interpreted looking for any relevant peak that assured the presence of beryllium-7. The fact that the isotope has a 53.28 days half life was taken into account when the data was interpreted. Also, the geometry factor was considered.

Introduction

The origin of atmosphere radioactivity is due to natural radioactive decay, cosmogenic production, nuclear weapon testing and nuclear accidents. Many different reactions take place in our atmosphere. One of the most abundant cosmogenic radionuclides is ⁷Be, which is a spallation product formed by the disintegration of nuclei of nitrogen and oxygen atoms that were hitten by cosmic ray neutrons. It is produced in the stratosphere (75%) and in the upper troposphere (25%). The highest values of ⁷Be are during spring because of the increased stratospheric – tropospheric mixing during the season, this makes it a very sensitive indicator of intrusions of stratospheric

Introduction (cont.)

air into the troposphere. The interactions between the stratosphere and the troposphere are increasingly important in the chemical and radioactive balance of our planetary atmosphere (Gaffney et al., 1993). The concentration of ⁷Be on the surface air depends on cosmic ray intensity, stratosphere-troposphere exchange, variations in vertical mixing of the troposphere, variations in horizontal transport of air masses from middle latitudes towards polar regions and the effect of wet and dry deposition of the carrier aerosols. After created, the ⁷Be atoms as well as other natural radionuclides participate in the formation and growth of the accumulation mode of

Introduction (cont.)

aerosols, which is a major reservoir of pollutants in the atmosphere (Dueñas et al., 1999). As this radionuclide is attached to submicron-sized aerosols, its concentration is related to aerosol dynamics and other processes as cloud nucleization, wet removal or vertical transports. ⁷Be may also be able to enter in the marine, terrestrial and vegetation environment. It is water-soluble and before deposition will tend to associate with particulate material. The half-life of ⁷Be isotope is 53.28 days, which makes the isotope a very short-lived one. Differences in the chemical environment of high pressures can produce a change of 0.2% in the half-



life of the isotope. The decay of ⁷Be into ⁷Li is possible via e- capture and leads to the emission of 477 KeV gamma ray.

What is ⁷Be?

- One of the most abundant cosmogenic radionuclides.
- Produced in:
 - Stratosphere
 - Upper troposphere
- 7 Be \rightarrow 7 Li via e- capture ($t_{1/2}$ = 53.28 days)

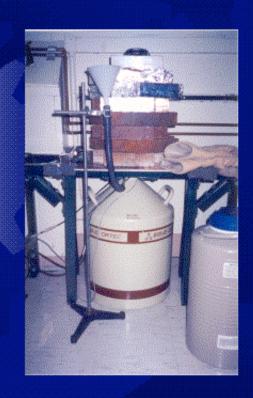


- Associates with submicron-sized aerosols.
- Sensitive indicator of intrusions of stratospheric air into the troposphere.
- May enter in the marine, terrestrial and vegetation environment.

About the instruments...

- High Volume Impactor
 - Draws air through a filter.
- HPGe Intrinsic Germanium crystal
 (EG + G-ORTEC Gem Series, 123% efficiency) and 92X Spectrum Master connected to a PC.
 - Germanium crystal
 - Gamma rays detector.
 - Multichannel analyzer (MCA)
 - Records the number of signal pulses occurring at different pulse heights.
 - Software
 - Maestro II

Instruments





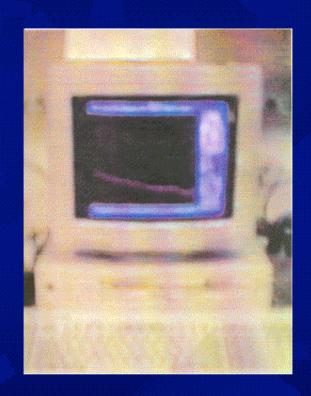
HPGe Intrinsic Germanium crystal with shielding

Instruments (cont.)



92X Spectrum Master connected to a PC





Computer's screen while analyzing a filter

Experimental Methods

- Sample sites
 - Clinton
 - Galveston
 - Harris
 - HCNW
- Sample collection
 - High Volume Impactor
 - 24 hours ran
 - Filters changed every 3-6 days (depending the location)

Experimental Methods (cont.)

- Sample preparation
 - Building a shield...
 - Needed to lower the background
 - HPGe Intrinsic Germanium crystal and 92X
 Spectrum Master connected to a PC
 - Direct low-level gamma counting

Data Analysis

- Software
 - MAESTRO II
 - Background

$$\mathbf{B} = \begin{cases} \begin{cases} \mathbf{I} + 2 & \mathbf{h} \\ \sum \mathbf{C_i} + \sum \mathbf{C_i} \\ \mathbf{i} = \mathbf{I} & \mathbf{i} = \mathbf{h} - 2 \end{cases}$$
 (h-I+1)/6

Where

B is the background area

I is the ROI low limit

h is the ROI high limit

C_i is the contents of channel i

6 is the number of data channel used (3 on each end)

Adjusted Gross Area

$$A_{ag} = \sum_{i=1+3}^{h-3} \mathbf{C}_{i}$$

Where

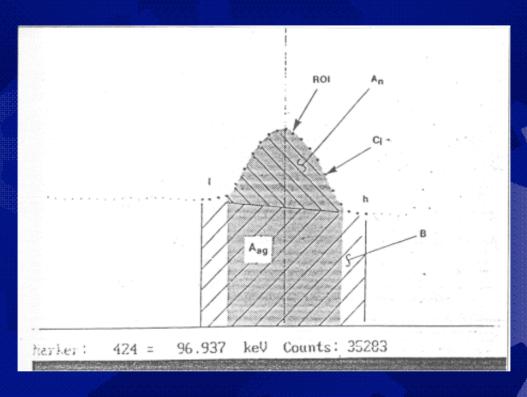
A_{ag} is the adjusted gross counts in the ROI

Net Area
$$A_n = A_{ag} - \left\{ B(h-l-5) / (h-l+1) \right\}$$

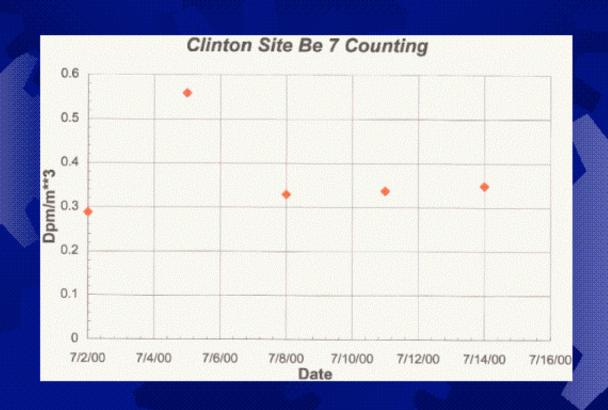


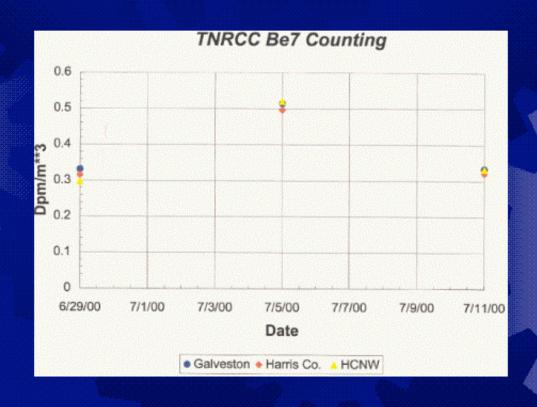
Conversion to counts per minute

Net Area / (Life Time / 60)



Background calculation





Future Work

One of the fields that have not been studied in depth in the past is the atmospheric science. Due to public awareness on certain issues, scientists are starting to pay attention to the importance of this field. Puerto Rico, which is strategically located right smack in the middle of the Caribbean, is now the focus of most scientist's research. A field study is planned in Puerto Rico for year 2002. During this study are doing to measure natural we radiochemical tracers as ⁷Be and other components of the atmosphere. In the mean time, a preliminary study on ozone is being planned for next year.



- Next Year
 - Preliminary study on ozone
- Year 2002
 - Complete Field Study

Conclusion

The ⁷Be isotope has a very short half-life. After surrounding the Ge crystal with a shield of lead bricks, the background decreased, giving us a better capacity to detect the gamma emissions of ⁷Be. When doing the calculations we had to consider the 0.7 geometry factors for an accurate result. Although all the sites are different, the data for July 5th, 2000 is mostly the same at each site. The fact that horizontal transport of air masses exits, can be the answer to these results.



- After shielding
 - Better capacity to detect the gamma emissions of ⁷Be.
- July 5th data was mostly the same at each site.



- Dueñas, C., Fernández, M.C., Liger, E., and Carretero, J., 1999.
 "Gross alpha (α), gross beta (β) activities and ⁷Be concentrations in surface air: analysis of their variations and prediction model" Atm. Env. 33, 3705-3715.
- Elbern, H.,

Acknowledgments

Most of all, thanks to Paul Drayton who worked with me all summer and helped me with the poster. Also, I appreciate all the help from the people in the Global Change Education Program (GCEP) who have made this summer a very good and special experience: Dr. Nancy Marley, Dr. Jeff Gaffney, Dr. Kent Orlandini, Pat Shoulders, Milton Constantin and Mary Kinney. Finally, Dr. Brad R. Weiner, to whom I am so grateful for his support and encouragement.